plural stages of optical fiber amplifiers which serially amplifies the laser light generated by the laser light generation section, and a narrow band filter and an isolator between the plural stages of the optical fiber amplifiers; and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

Cont A2

Page 8, lines 16-27 and Page 9, lines 1-8, delete current paragraph and insert therefor:

A3

A second exposure apparatus of the present invention illuminates a pattern of a first object with ultraviolet light output from a laser device and exposes a second object with the ultraviolet light which has passed through the first object, wherein the laser device includes a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region; an optical amplification section including plural stages of amplifying optical fibers which amplify the laser light generated by the laser light generation section, an excitation-light generating light source which generates a plurality of amplifying excitation light beams, a narrow band filter or an isolator disposed between the plurality of the amplifying optical fibers, and a bypass member which passes the excitation light in parallel to the narrow band filter or the isolator; and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

Page 9, lines 9-27 and Page 10, line 1, delete current paragraph and insert therefor:

A4

A third exposure apparatus of the present invention illuminates a pattern of a first object with ultraviolet light from a laser device and exposes a second object with the ultraviolet light which has passed through the pattern of the first object, wherein the laser device includes a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region; an optical amplification section

section including plural stages of optical fiber amplifiers which amplify the laser light generated by the laser light generation section, a plurality of excitation-light generating light sources which individually generate excitation light for each of the plural stages of the amplifying optical fibers, and a narrow band filter, a reflection film which reflects the excitation light being formed at one of each of the optical fibers coupled to both sides of the narrow band filter; and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

Cont A4

Page 10, lines 2-22, delete current paragraph and insert therefor:

A5

A fourth exposure apparatus of the present invention illuminates a pattern of a first object with ultraviolet light from a laser device and exposes a second object with the ultraviolet light which has passed through the first object, wherein the laser device includes a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region; an optical modulation section which modulates the laser light generated by the laser light generation section with a predetermined repetition frequency into pulsed light having a predetermined width; an optical amplification section including an optical fiber amplifier which amplifies the laser light which has passed through the optical modulation section; and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal, the width of the pulsed light modulated by the optical modulation section is set wider than a pulsewidth set for obtaining a predetermined wavelength width with finally generated ultraviolet light.

Page 10, lines 23-27 and Page 11, lines 1-13, delete current paragraph and insert therefor:

A fifth exposure apparatus of the present invention illuminates a pattern of a first object with ultraviolet light from a laser device and exposes a second object with the ultraviolet light which has passed through the first object, wherein the laser device includes a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region; an optical amplification section including an optical fiber amplifier which amplifies the laser light generated by the laser light generation section, a transmitting optical fiber which propagates the laser light amplified by the optical fiber amplifier, and a narrow band filter disposed between the optical fiber amplifier and the transmitting optical fiber; and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

A6

Page 11, lines 14-27 and Page 12, lines 1-3, delete current paragraph and insert therefor:

A sixth exposure apparatus of the present invention illuminates a pattern of a first object with ultraviolet light from a laser device and exposes a second object with the ultraviolet light which has passed through the first object, wherein the laser device includes a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region, an optical splitter which splits the laser light into a plurality of laser light beams, a plurality of optical fiber amplifiers which respectively and independently amplify the plurality of split laser light beams, a wavelength conversion section which performs wavelength conversion of the amplified laser light beams, and the laser device includes a regulator which regulates an amplification gain at at least one of the plurality of the optical fiber amplifiers so that outputs of the plurality of amplified laser light beams are substantially uniformalized.

A7

Page 17, lines 14-27 and Page 18, lines 1-3, delete current paragraph and insert therefor:

A8

Preferably, each of the above-described laser devices is configured to further include an optical splitter which splits the laser light generated by the laser light generation section into a plurality of laser light beams, and, in this configuration, optical amplification sections are independently provided for the plurality of split laser beams respectively, and the wavelength conversion section collects fluxes of laser beams output from the plurality of optical amplification sections and performs wavelength conversion thereof. Thus, the laser light split by the optical splitters are sequentially imparted with predetermined differences in optical path lengths and therefore, the spatial coherence of the laser light finally bundled can be reduced. Moreover, since each of the laser light beams is generated by the common laser light generation section, the spectral linewidth of the finally obtained ultraviolet light is narrow.

Page 19, lines 19-27 and Page 20, line 1, delete current paragraph and insert therefor:

A9

B1

The exposure apparatus of the present invention further includes an illumination system which irradiates a maskwith ultraviolet light from the laser device, and a projection optical system which projects an image of a pattern of the mask onto a substrate, wherein the substrate is exposed with the ultraviolet light passed through the pattern of the mask. With the laser device of the present invention being used, the exposure apparatus can be miniaturized overall, and the maintainability thereof is increased.

Page 20, lines 9-27, delete current paragraph and insert therefor:

A10

Hereinbelow, a first exposure apparatus manufacturing method according to the present invention is a method of manufacturing an exposure apparatus which illuminates a pattern of a first object with ultraviolet light from a laser device and which expose a second object with the ultraviolet light which has passed through the pattern of the first object,

Cont A10

wherein the laser device is configured by disposing with a predetermined relationship, a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region, plural stages of optical fiber amplifiers which serially amplify the laser light generated by the laser light generation section, an optical amplification section including a narrow band filter and an isolator between the plural stages of optical fiber amplifiers, and a wavelength conversion section which performs wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

Page 21, lines 1-23, delete current paragraph and insert therefor:

A11

A second exposure apparatus manufacturing method according to the present invention is a method of manufacturing an exposure apparatus which illuminates a pattern of a first object with ultraviolet light from a laser device and which exposes a second object with the ultraviolet light which has passed through the pattern of the first object, wherein the laser device is configured by disposing with a predetermined relationship, a laser light generation section which generates single wavelength laser light in a wavelength range of from an infrared region to a visible region; an optical amplification section including plurality of amplifying optical fibers which amplify the laser light generated by the laser light generation section, an excitation-light generating light source which generates a plurality of amplifying excitation light beams, a narrow band filter or an isolator disposed between the plurality of amplifying optical fibers, and a bypass member which passes the excitation light in parallel to the narrow band filter or the isolator; and a wavelength conversion section for performing wavelength conversion of the laser light amplified by the optical amplification section into ultraviolet light by using a nonlinear optical crystal.

Page 22, lines 2-4, delete current paragraph and insert therefor:

A12

Figs. 1A and 1B are diagrams showing an example of an ultraviolet light generator according to an embodiment of the present invention.

Page 22, lines 5-7, delete current paragraph and insert therefor:

A13

Fig. 2 is a diagram showing a first configuration example of optical amplifier units 18-1 to 18-n shown in Figs. 1A and 1B.

Page 22, lines 16-19, delete current paragraph and insert therefor:

A14

Figs. 7A, 7B and 7C are diagrams showing waveforms of laser beams in individual portions of another example according to the present embodiment of the present invention.

Page 22, lines 20-24, delete current paragraph and insert therefor:

A15

Fig. 8A is a diagram showing a first configuration example of a wavelength conversion section 20 shown in Figs. 1A and 1B, and Fig. 8B is a diagram showing a second configuration example of the wavelength conversion section 20.

Page 22, line 25 and Page 23, lines 1-4, delete current paragraph and insert therefor:

A16

Fig. 9A is a diagram showing a third configuration example of a wavelength conversion section 20, and Fig. 9B is a diagram showing a fourth configuration example of the wavelength conversion section 20.

Page 23, lines 21-17 and Page 24, lines 1-3, delete current paragraph and insert therefor:

A17

Fig. 1A shows an ultraviolet light generator according to the present example. Referring to Fig. 1A, a single wavelength oscillatory laser 11, which is provided as a laser light generation section, generates a laser beam LB1 that is formed of a continuous wave (CW) having a narrow spectral width and that has a wavelength of 1.544 μm. The laser beam LB1 is incident on an optical modulating device 12, which is provided as an optical modulator, via an isolator IS1 provided for blocking reverse light. The laser beam LB1 is

Cont A17

converted therein into a laser beam LB2 (pulsed beam), and the laser beam LB2 is then incident on an optical splitting amplifier section 4.

Page 27, lines 8-24, delete current paragraph and insert therefor:

A18

Moreover, as shown in Fig. 1B, output terminals 19a of the fiber bundle 19 are bundled such that the m·n optical fibers (128 optical fibers in the present example) tightly contacts one another, and the outer shape thereof is circular in a cross-sectional view. In a practical configuration, however, the outer shape of the output terminals 19a and the number of optical fibers are determined according to, for example, the rear-stage configuration of the wavelength conversion section 20 and use conditions of the ultraviolet light generator of the present example. The clad diameter of each of the optical fibers constituting the fiber bundle 19 is about 125 μm. Accordingly, when 128 optical fibers are bundled circular, a diameter d1 of each of the output terminals 19a can be set to about 2 mm or smaller. The configuration of the optical splitting amplifier section 4 is not limited to that shown in ~~Fig. 1~~ Figs. 1A and 1B. For example, a time division multiplexer may be used as an optical splitter.

Page 29, lines 20-27 and Page 30, lines 1-11, delete current paragraph and insert therefor:

Page 29, lines 20-27 and Page 30, lines 1-11:

A19

Hereinbelow, the present embodiment will be described in further detail. Referring to Fig. 1A, for the single wavelength oscillatory laser 11 oscillating at a single wavelength, the present example uses, a laser, such as a distributed feedback (DFB) semiconductor laser. The DFB semiconductor laser is characterized by an InGaAsP construction, a 1.544 μm oscillation wavelength, and a 20 mW continuous output (which hereinbelow will be referred to as "CW output"). In addition, the DFB semiconductor laser is configured such that, instead of a Fabry-Pelot resonator, a diffraction grating is formed in a semiconductor laser, in which single longitudinal mode oscillation is performed under any condition. Thus, since the

Cont A19

DFB semiconductor laser performs the single longitudinal mode oscillation, the oscillation spectral linewidth can be controlled to be 0.01 pm or less. Alternatively, for the single wavelength oscillatory laser 11, the present example may be configured using a light source such as an erbium(Er)-doped fiber laser capable of generating a laser beam having a wavelength region similar to the above and a narrowed bandwidth.

Page 40, lines 26-27 and Page 41, lines 1-16, delete current paragraph and insert therefor:

A20

Referring to Fig. 1A, the laser beams passed through the m-group delay fibers (optical fibers 17-1 to 17-n) are incident on the respective optical amplifier units 18-1 to 18-n, and are amplified thereby. The individual optical amplifier units 18-1 to 18-n of the present example have optical fiber amplifiers. However, as in the case of, particularly, the last-stage optical fiber amplifier, when high-intensity light propagates through the optical fibers, the wavelength width of the propagated light is expanded by influences of, for example, SPM (self phase modulation), SRS (stimulated raman scattering), and SBS (stimulated brillouin scattering), which are attributable to the optical-fiber nonlinear effects. Hereinbelow will be described an example configuration that mitigates the wavelength width expansion by reducing the influence of the nonlinear effects. While description given hereinbelow will cover several example configurations of an optical amplifier unit that may be used for the optical amplifier unit 18-1, the example configurations may similarly be used for the other optical amplifier units 18-2 to 18-n.

Page 42, lines 26-27 and Page 43, lines 1-11, delete current paragraph and insert therefor:

A21

In the present example, the laser beam LB3 from the optical fiber 17-1 shown in Fig. 1A is led via the WDM device 21A to be incident on the amplifying optical fiber 22, and is amplified thereby. Then, the laser beam LB3 amplified by the amplifying optical fiber 22 is

Cont Ad1

incident on the amplifying optical fiber 25 via the WDM device 21B, the narrow band filter 24A, the isolator IS3, and WDM device 21C; and the incident laser beam LB3 is thereby amplified again. Via the WDM device 21D, the amplified laser beam LB3 propagates through one of optical fibers that constitute the fiber bundle 19 shown in Fig. 1A(the aforementioned optical fiber may be an extended portion of an output terminal of the amplifying optical fiber 25).

Page 43, lines 12-26, delete current paragraph and insert therefor:

Ad2

The total of amplification gains according to the second-stage optical fiber amplifiers 22 and 25 is 46 dB (39,810 times) as one example. When the total number of channels (m·n pieces) output from the splitters 16-1 to 16-m shown in Fig. 1B is 128, and the average output power of each of the channels is about 50 μm, the average output power of all the channels is about 6.4 mW. When a laser beam of each of the channel is amplified at about 46 dB, the average output power of the laser beam output from each of the optical amplifier units 18-1 to 18-n is about 2 W. When the above is assumed to have been pulsed at a pulsewidth of 1 ns, and a pulse frequency of 100 kHz, the peak output power of each of the laser beams is 20 kW. Also, the average output power of the laser beam Lb4 output from the fiber bundle 19 is about 256 W.

Page 43, lines 27 and Page 44, lines 1-13, delete current paragraph and insert therefor:

Ad3

In the present example, coupling losses in the splitters 14 and 16-1 to 16-m shown in Fig. 1A are not taken into consideration. However, even when the coupling losses occur, the output powers of the laser beams of the individual channels can be unformed to be the above-described value (for example, the peak output power of 20 kW). This can be achieved by increasing at least one of the amplification gains obtained according to the optical fiber amplifiers 22 and 25 by the amount of the loss. In addition, the value of the output power (output power of the fundamental wave) of the single wavelength oscillatory laser 11 shown

Cont A23

in Fig. 1A can be controlled larger or smaller than the aforementioned value. This can be achieved by controlling the amplification gains obtained according to the optical fiber amplifiers 22 and 25.

Page 44, lines 14-27 and Page 45, lines 1-4, delete current paragraph and insert therefor:

A24

Referring to the example configuration shown in Fig. 2, the narrow band filter 24A removes ASE (amplified spontaneous emission) light occurring in each of the optical fiber amplifier 13 shown in Fig. 1A and the amplifying optical fiber 22 shown in Fig. 2, and lets the laser beam (having a wavelength width of 1 pm or less) output from the single wavelength oscillatory laser 11 shown in Fig. 1A to transmit. Thereby, the narrow band filter 24A substantially makes the wavelength width of the transmitted beam to be a narrow band. This enables the amplification gain of the laser beam to be prevented from being reduced by the incidence of the ASE light. In this case, the narrow band filter 24A preferably has a transmission wavelength width of about 1 pm. However, since the wavelength width of the ASE light is several tens of nm, the ASE light can be removed not to cause a problem in practice even by using a currently available narrow band filter with a transmission wavelength width of about 100 pm.

Page 45, lines 5-11, delete current paragraph and insert therefor:

A25

Suppose the output wavelength of the single wavelength oscillatory laser 11 in Fig. 1A is positively changed. In this case, while the narrow band filter 24A may be replaced according to the output wavelength. However, preferably, a narrow band filter having a transmission wavelength width (equivalent to a variable range (about ±20 pm, as mentioned above as an example, for an exposure apparatus) is used.

Page 50, lines 25-27 and Page 51, lines 1-14, delete current paragraph and insert therefor:

A26

Hereinbelow, another example of the present embodiment according to the present invention will be described with reference to Figs. 1A, 1B, 2, 7A, 7B, and 7C. According to the above-described embodiment, the pulsewidth of the laser beam output from the optical modulating device 12 shown in Fig. 1A is set to about 1 ns. With the pulsewidth which is thus short, when the peak output power is increased, an unexpected case can occur in which the frequency expansion is increased due to SPM (self phase modulation), particularly in the rear-stage optical fiber amplifier. As such, in the present example, the width of the output pulse in the optical modulating device 12 is set to a width that is several times a pulsewidth (about 1 ns in the present example) which is determined depending on the transfer limit in a required frequency width, for example, in a range of from 2 to 5 ns, and the pulse waveform is controlled to maximize the pulse transient time.

Page 51, lines 15-27 and Page 52, lines 1-3, delete current paragraph and insert therefor:

A27

Figs. 7A, 7B and 7C show example pulse waveforms in individual portions. Intensity variations with respect a time t of the laser beam LB2 output from the optical modulating device 12 shown in Fig. 1A are represented as a waveform 28A shown by a solid line in Fig. 7B. Fig. 7B shows that a pulsewidth ΔtA of the waveform 28A is set to a level of two times a pulsewidth ΔtB of a waveform 28B, shown by a dotted line, which is determined depending on the transfer limit in a desired frequency width. In this case, the laser beam LB1 output from the single wavelength oscillatory laser 11 shown in Fig. 1A may be a CW wave as shown by the solid line in Fig. 7A. However, when the laser beam LB1 is controlled to be a pulsed beam having a width larger than the pulsewidth ΔtA, as a waveform 27 shown by a double-dotted chain line, use efficiency of the laser beam can be improved.

Page 52, lines 4-20, delete current paragraph and insert therefor:

In addition, suppose the optical amplifier unit 18 shown in Fig. 2 is assumed to be used for the optical amplifier unit 18-1 shown in Fig. 1A. In this case, when the pulsewidth of the laser beam LB2 is increased as described above, while the SPM influence is reduced particularly in the last-stage optical fiber amplifier 25, the SBS (stimulated brillouin scattering) influence is increased. Nevertheless, however, bleaching of the gain occurs in the last-stage optical fiber amplifier 25. Hence, as shown by a solid line of waveform 29A in Fig. 7C, the pulsewidth of the laser beam LB3 output from the optical amplifier unit 18 is reduced shorter than that of a waveform 29B that is shown by a dotted line and that corresponds as is to the laser beam LB2. Thereby, the adverse effect of the pulsewidth expanded in the optical modulating device 12 is reduced; and consequently, the wavelengths-in-width of ultraviolet lights to be finally output overall can be narrowed.

A27

Page 52, between lines 21-27 and Page 53, lines 1-13, insert a new paragraph as follows:

In the above-described embodiment, the laser light source having an oscillation wavelength of about 1.544 μm is used for the single wavelength oscillatory laser 11. Instead of this laser light source, however, the embodiment may use a laser light source having an oscillation wavelength in a range of from 1.099 to 1.106 μm. For this laser light source, either a DFB semiconductor laser or an ytterbium(Yb)-doped fiber laser may be used. In this case, for the optical fiber amplifier in the rear-stage optical amplification section, the configuration may use an ytterbium(Yb)-doped fiber (YDFA) that performs amplification in a wavelength zone of 990 to 1200 nm including the wavelength of the amplifier section. In this case, ultraviolet light having a wavelength of 157 to 158 nm wave that is substantially the same wavelength of the F_2 laser can be obtained by outputting the seventh-order harmonic wave in the wavelength conversion section 20 shown in Fig. 1B. In practice, ultraviolet light

A28

Cont
A29

having substantially the same wavelength as that of the F_2 laser can be obtained by controlling the oscillation wavelength to be about 1.1 μm.

Page 57, lines 17-20, delete current paragraph and insert therefor:

A29

Hereinbelow, a description will be made regarding example configurations of the wavelength conversion section 20 used in the ultraviolet light generator of the embodiment shown in Figs. 1A and 1B.

Page 57, lines 21-27 and Page 58, lines 1-20, delete current paragraph and insert therefor:

A30

Fig. 8A shows the wavelength conversion section 20 that is capable of obtaining the eighth-order harmonic wave through repetition of the second-order harmonic wave generation. In Fig. 8A, the fundamental wave of the laser beam LB4 having a wavelength of 1.544 μm (the frequency is represented by "ω") output from an output terminal 19a of an optical fiber bundle 19 is incident on a first-stage nonlinear optical crystal 502. The second-order harmonic wave generation is performed therein to generate the second-order harmonic wave having a twofold frequency 2ω (wavelength: 1/2 of 772 nm) of the frequency ω. The generated second-order harmonic wave is then incident on a second-stage nonlinear optical crystal 503 through a lens 505. Similar to the above, through the second-order harmonic wave generation, there is generated fourth-order harmonic wave having a twofold frequency of the frequency 2ω of the incident wave, that is, a fourfold frequency 4ω (wavelength: 1/4 of 386 nm) with respect to the fundamental wave. The generated fourth-order harmonic wave is then transferred to a third-stage nonlinear optical crystal 504 through a lens 506. Similarly, through the second-order harmonic wave generation, there is generated eighth-order harmonic wave having a twofold frequency of the frequency 4ω of the incident wave, that is, an eightfold frequency 8ω (wavelength: 1/8 of 193 nm) with respect to the fundamental wave. The eighth-order harmonic wave is output as laser beam LB5. Thus, the example

Cont A30

configuration performs wavelength modulations in the following order: fundamental wave (wavelength: 1.544 μm) → second-order harmonic wave (wavelength: 772 nm) → fourth-order harmonic wave (wavelength: 386 nm) → eighth-order harmonic wave (wavelength: 193 nm).

Page 59, lines 20-27 and Page 60, lines 1-5, delete current paragraph and insert therefor:

A31

Referring to Fig. 8A, a converging lens, which is effective for improving the incidence efficiency of laser beam LB4, is preferably provided between the fiber bundle 19 and the nonlinear optical crystal 502. In this case, each of the optical fibers constituting the fiber bundle 19 has a mode diameter (core diameter) of about 20 μm, and a region where the conversion efficiency in the nonlinear optical crystal has a size of about 200 μm. As such, a lens with a very low magnification of about 10× magnification may be provided in units of the optical fiber to converge the laser beam output from each of the optical fibers into the nonlinear optical crystal 502. This applies also to other example configurations described below.

Page 60, lines 6-25, delete current paragraph and insert therefor:

A32

Fig. 8B shows a wavelength conversion section 20A that is capable of obtaining the eighth-order harmonic wave by combining the second-order harmonic wave generation and sum frequency generation. Referring to Fig. 8B, the fundamental wave of the laser beam LB4 having a wavelength of 1.544 μm output from the output terminal 19a of the fiber bundle 19 is incident on a first-stage nonlinear optical crystal 507 formed of the LBO crystal and controlled by the NCPM method. In the crystal 507, there is generated the second-order harmonic wave (wavelength: 722 nm) according to the second-order harmonic wave generation. In addition, a part of the fundamental wave is transmitted as is through the nonlinear optical crystal 507. Both the fundamental wave and second-order harmonic wave

Cont
A32

in a linearly polarized state are transmitted trough a wavelength plate 508 (for example, a 1/2 wavelength plate), and only the fundamental wave is output in a 90-degree rotated direction of polarization. The fundamental wave and the second-order harmonic wave individually pass through a lens 509 and are incident on a second-stage nonlinear optical crystal 510.

Page 63, lines 8-27, delete current paragraph and insert therefor:

Page 63, lines 8-27:

A33

The configuration between the second-stage nonlinear optical crystal 510 and the fourth-stage nonlinear optical crystal 517 is not limited to that shown in Fig. 8B. This configuration may be arbitrarily arranged as long as it has the same optical path lengths for the sixth-order harmonic wave and the second-order harmonic wave to cause the sixth-order harmonic wave and the second-order harmonic wave to be incident on the fourth-stage nonlinear optical crystal 517. Moreover, for example, the third-stage and fourth-stage nonlinear optical crystals 514 and 517 may be disposed on the same optical axis of the second-stage nonlinear optical crystal 510. In this configuration, the third-stage nonlinear optical crystal 514 is used to convert only the third-order harmonic wave into the sixth-order harmonic wave according to the second-order harmonic wave generation, and the converted harmonic wave and the non-converted second-order harmonic wave together may be incident on the fourth-stage nonlinear optical crystal 517. This configuration avoids the necessity of using the dichroic mirrors 511 and 516.

Page 64, lines 1-19, delete current paragraph and insert therefor:

A34

For the individual wavelength conversion sections 20 and 20A shown in Figs. 8A and 8B, the average output power of the per-channel eighth-order harmonic waves (wavelength: 193 nm) were experimentally obtained. As described in the above-described embodiment, the output of the fundamental wave at each of the channel output terminal is characterized by a peak power of 20 kW, a pulsewidth of 1 ns, a pulse repetition frequency of 100 kHz, and an

average output power of 2W. As a result, the per-channel average output powers of the eighth-order harmonic waves were 229 mW in the wavelength conversion section 20 shown in Fig. 8A, and 38.3 mW in the wavelength conversion section 20A shown in Fig. 8B. Accordingly, the average output powers from the bundle of all the 128 channels are 29 W in the wavelength conversion section 20, and 4.9 W in the wavelength conversion section 20A. As such, in either of the wavelength conversion sections 20 and 20A, ultraviolet light having a wavelength of 193 nm beam, which is sufficient as an exposure-apparatus-dedicated light source can be provided.

Cont
A34

Page 65, lines 18-27, delete current paragraph and insert therefor:

Hereinbelow, a description will be made regarding an example configuration of a wavelength modulator section that enables ultraviolet light having substantially the same wavelength as that of the F_2 laser (wavelength: 157 nm). To implement the above, as the wavelength conversion section 20, the configuration may be arranged to use a wavelength conversion section capable of generating the tenth-order harmonic wave with 1.57 μm wavelength of the fundamental wave generated in the single wavelength oscillatory laser 11 shown in Fig. 1A.

A35

Page 66, lines 1-16, delete current paragraph and insert therefor:

Fig. 9A shows a wavelength conversion section 20B that enables the tenth-order harmonic wave to be generated through combination of the second-order harmonic wave generation and the sum frequency generation. Referring to Fig. 9B, the fundamental wave of the laser beam LB4, having a wavelength of 1.57 μm, which has been output from the output terminal 19a of the fiber bundle 19, is incident on a first-stage nonlinear optical crystal 602 formed of the LBO crystal, and is converted into the second-order harmonic wave according to the second-order harmonic wave generation. The second-order harmonic wave is then incident on a second-stage nonlinear optical crystal 604 formed of LBO via a lens 603, and is

A36

Cont A36

converted into the fourth-order harmonic wave according to the second-order harmonic wave generation; and a part of the second-order harmonic wave is transmitted therethrough without being converted.

Page 68, lines 18-27 and Page 69, lines 1-8, delete current paragraph and insert therefor:

A37

Fig. 9B shows a wavelength conversion section 20C that enables the seventh-order harmonic wave to be generated through combination of the second-order harmonic wave generation and the sum frequency generation. Referring to Fig. 9B, the laser beam LB4 (fundamental wave), having a wavelength of 1.099 μm, which has been output from the output terminal 19a of the fiber bundle 19, is incident on a first-stage nonlinear optical crystal 702 formed of the LBO crystal, and the second-order harmonic wave is generated therein according to the second-order harmonic wave generation. A part of the fundamental wave is transmitted as is therethrough. Both the fundamental wave and second-order harmonic wave transmits in a linearly polarized state transmits through a wavelength plate 703 (such as a 1/2 wavelength plate), and only the direction of polarization of only the fundamental wave is rotated through 90 degrees. The fundamental wave and the second-order harmonic wave is led through a lens 704 to be incident on a second nonlinear optical crystal 705 formed of the LBO crystal. The third-order harmonic wave is generated therein according to the sum frequency generation, and a part of the second-order harmonic wave is transmitted as is therethrough.

Page 70, lines 23-27 and Page 71, lines 1-14, delete current paragraph and insert therefor:

A38

As is apparent from Fig. 1A, in the above-described embodiment, the combined light of the outputs of the n optical amplifier units 18-1 to 18-n in the m-group is converted in wavelength by using the single wavelength conversion section 20. Alternatively, however,

the configuration may be arranged such that, for example, m' units (m' = "2" or larger inger) wavelength conversion sections are provided. In the alternative configuration, the outputs of the m-group optical amplifier units 18-1 to 18-n are divided in units of n' outputs into m' groups, the wavelength conversion is performed for one of the wavelength conversion section in units of one of the groups, and the obtained m' ultraviolet light beams (in the present example, m' = "4", "5", or the like) are combined. Thus, the wavelength conversion section 20 is not limited to that having the above-described configuration. Moreover, for example, a CBO crystal (CsB_3O_5), a lithium tetraborate $Li_2B_4O_7$ (LBO), a KAB ($K_2Al_2B_4O_7$), or a GdYCOB ($Gd_XY_{1-x}Ca_4O(BO_3)_3$), may be used as an alternative crystal for the nonlinear optical crystal.

Cont A38

Page 71, lines 15-27 and Page 72, lines 1-3, delete current paragraph and insert therefor:

According to the ultraviolet light generator of the above-described embodiment, the diameter of the output terminal of the fiber bundle 19, shown in Fig. 1A, even with all the channels being included, is about 2 mm or smaller. As such, one or several units of the wavelength conversion sections 20 are sufficient to perform the wavelength conversion of all the channels. In addition, since flexible optical fibers are used for the output terminals, the flexibility in configuration is very high. For example, the configuration sections such as the wavelength conversion section, the single wavelength oscillatory laser, and the splitter, can be separately disposed. Consequently, the ultraviolet light generator of the present example enables the provision of an ultraviolet laser device that is inexpensive and compact, and has a low spatial coherence while it is of a single wavelength type.

A39

Page 72, lines 4-26, delete current paragraph and insert therefor:

Hereinbelow, an example exposure apparatus using the ultraviolet light generator shown in Fig. 1A will be described. Fig. 10 shows the exposure apparatus of the present

A40

Cont A40

example. Referring to Fig. 10, devices usable for an exposure light source 161 include, for example, a device with an ultraviolet region of 193 nm, 157 nm, or the like based on the wavelength of a laser beam that is output from the ultraviolet light generator shown in Fig. 1A. A laser beam LB5 that has been output from the exposure light source 161 is incident as exposure light IL on an illumination system 162. The illumination system 162 is configured of, for example, an optical integrator (homogenizer) for homogenizing illuminance distributions of the exposure light IL, an aperture diaphragm, a field diaphragm (reticle blind), and a condenser lens. In the aforementioned configuration, the exposure light IL output from the illumination system 162 illuminates a slit-like illumination region of a pattern surface of a reticle 163 set as a mask to provide a homogeneous illuminance distribution. In the present example, since the spatial coherence of the exposure light IL is so low that the configuration of a member for reducing the spatial coherence in the illumination system 162 can be simplified, and the exposure apparatus can therefore be further miniaturized.

Page 74, lines 22-27 and Page 75, lines 1-19, delete current paragraph and insert therefor:

A41

Exposure-light-amount control in the above-described scan-exposure operation may be implemented in the following manner. Control is performed for at least one of the pulse repetition frequency f, which is defined by the optical modulating device 12 shown in Fig. 1A, and the interchannel delay time, which is defined by the delaying devices (optical fibers 15-1 to 15-m, and 17-1 to 17-n). The control is thus performed to cause a fundamental-wave generator section 171 to oscillate a plurality of pulsed beams at equal time intervals during scan-exposure operation. In addition, according to the sensitivity property of the photoresist, at least one of the optical intensity of the pulsed beam on the wafer 166, the scan speed for the wafer 166, the pulsed-beam oscillation interval (frequency), and the width of the pulsed beam in the scan direction for the wafer 166 (that is, an radiation region thereof) to thereby

control the integrated luminous quantity of a plurality of pulsed beams irradiated in a period in which the individual points of the wafer traverse the radiation region. At this time, in consideration of the throughput, least one of other control parameters representing the pulsed-beam optical intensity, the oscillation frequency, and the radiation region width is preferably controlled so that the scan speed for the wafer 166 is substantially maintained to be the maximum speed of the wafer stage 167.

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Page 75, lines 20-27 and Page 76, lines 1-8, delete current paragraph and insert therefor:

A42

Fig. 11 shows another exposure apparatus using the ultraviolet light generator of the present example. Referring to Fig. 11, the ultraviolet light generator shown in Fig. 1A is attached apart. Specifically, referring to Fig. 11 showing the portions corresponding to those shown in Fig. 10 by assigning the same reference symbols, a wavelength conversion section 172 corresponding to the wavelength conversion section 20 shown in Fig. ~~1(a)~~ 1A is mounted on the exposure apparatus mainbody. On the other hand, a light-source mainbody section 171 corresponding to the members of from the single wavelength oscillatory laser 11 to optical splitting amplifier section 4 shown in Fig. 1A are provided outside of the exposure apparatus mainbody, and a coupling-dedicated optical fiber 173 is used to couple therebetween. The coupling-dedicated optical fiber 173 corresponds to the fiber bundle 19 shown in Fig. 1A.

Page 78, lines 8-18, delete current paragraph and insert therefor:

A43

In the present example, a laser beam from the light-source mainbody section 171 is fed to a wavelength conversion section 179 via an optical fiber 178. For the wavelength conversion section 179, the present example uses a wavelength conversion section that is similar to the wavelength conversion section 20 shown in Fig. 1A and that is relatively small. The wavelength conversion section 179 is integrally provided on the frame that holds the

Cont A43

alignment system 180, in which ultraviolet light that has been output from the wavelength conversion section 179 is used as illumination light.

Page 79, lines 9-25, delete current paragraph and insert therefor:

A44

The exposure apparatus of the above-described embodiment shown, for example, in Fig. 11, may include a spatial-image measuring system. The spatial-image measuring system may be such that the mark provided on the reticle 163 and the reference mark provided on the reticle stage 164 are illuminated with illumination light having the same wavelength, and a mark image formed by the projection optical system 165 is detected through an opening (such as a slit) provided on the wafer stage 167. For a light source generating the illumination light for the spatial-image measuring system, a light source (similar to the ultraviolet light generator shown in Figs. 1A and 1B) having the same configuration as that of the above-described light source (171 and 179) may be separately provided. Alternatively, the exposure-dedicated light source formed of the members including the light-source mainbody section 171 and the illumination system 162 may be shared.

Page 79, lines 26-27 and Page 80, lines 1-10, delete current paragraph and insert therefor:

A45

In the above-described embodiment, description has been made that the laser device shown in Figs. 1A and 1B is used either as the exposure-dedicated light source or as the light source of the alignment system or the spatial-image measuring system. However, the laser device may be used as a regulating light source of a detecting system or an optical system for marks other than the above. In addition, the laser device may be used not only as the light source of the exposure apparatus, the testing apparatus, or the like used in the device-manufacturing step, but also as a light source of various other apparatuses, regardless of the use and like thereof (an example is an apparatus using an excimer laser as a light source, such as a laser medical treatment apparatus for performing medical treatment for, for example, the